PATENT SPECIFICATION

Application Date: Dec. 15, 1924. No. 30,134/24. 238,441

Complete Accepted: Aug. 20, 1926.

COMPLETE SPECIFICATION.

Improvements in and relating to Electric Lift Machines and the like.

I, JOHN BERTRAM MORTON KNUTSEN, of "Lorne", Roslyn Gardens, Elizabeth Bay, Sydney, in the State of New South Wales, Commonwealth of Australia, Engineer, a subject of the King of Great Britain, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in and connected with electric lift machines and the like, and more particularly to improved lift-car levelling apparatus and to automatic control means therefor.

In electrically operated and electrically controlled lifts of ordinary type skill and accuracy are required on the part of a lift attendant to stop the lift car at exactly a required floor level, due particularly to the tendency of the car to over-run the stopping point, even after the lift motor has been switched off and the brakes have been applied to the lift machine. At varying speeds of travel and with varying car loads this disadvantage is augmented with the result that the lift attendant has frequently to reverse the lift motor several times during one trip to return the lift car to the correct stopping points, and also to make contacts of short duration on the car switch to cause the lift car to travel but relatively short distances. These levelling operations cause jerky movements of the lift car, which is objectionable to the car passengers and is also harmful to the lift machine and motor, while being wasteful both of time and of electrical energy expended.

The present invention provides an automatic car levelling apparatus for an electrically operated lift which will ensure exact and accurate stopping of the lift car at floor levels or landings, regardless of the load and of the speed of the lift car, without necessitating reversing of the lift motor or forming contacts of short duration on the car switch.

The invention also provides car levelling apparatus for electrically operated lifts wherein the actual stopping of the lift car takes place at low speed so that the operation is exceedingly smooth and pleasant to passengers.

In electrically operated lifts or hoists it has been previously proposed to provide between the lift motor and the lift machine, a supplementary or auxiliary reducing gear which is normally locked to provide a solid drive, but which can be brought into operation to afford a reduced speed by disengaging the locking device and simultaneously arresting one of the elements of the gear mechanism. The standard electromagnetic brake is utilised for the latter purpose, while the operation of the reducing gear is regulated by a friction clutch controlled by a separate electromagnet. The energisation of the brake magnet and clutch magnet are determined by a levelling switch mounted on the lift car and provided with tappet arms or equivalent devices which engage with suitable ramps or strikers fixed in the lift shaft.

According to the present invention the supplementary or auxiliary gearing is controlled by selective control mechanism which is switched into or out of use automatically by the operation of the car switch by the lift attendant, and when in use is controlled by cam switches that are located in the lift well and are operated by a cam on the lift car.

The selective control mechanism is connected to the lift motor relays which it maintains closed when the car switch

has been switched off to keep the lift motor running in the same direction, until such time as the lift car has reached and is exactly level with the required stopping point.

The selective control mechanism includes relay control switches, which are preferably located on the lift control board and connected to electro-magnetically operated clutches and brakes provided upon the auxiliary reduction and reverse gearing. These clutches and brakes when operated by the relay control switches, throw the auxiliary reduction gearing into use and according to the position of the lift car relative to the required stopping point, said clutches and brakes also enable the lift machine to be driven either directly, or to be reversed as may be required to move the lift car to the selected stopping point.

The auxiliary reduction and reverse gearing provided upon the lift machine is preferably of the epicyclic type, and it comprises two gear cases, one of which accommodates speed reduction pinions in mesh with gear wheels that are fitted upon a central driving spindle. The other of said gear cases houses the electromagnetically operated clutches which enable both direct and reverse reduction drives to be obtained as required. The electro-magnetically operated brakes are arranged exteriorly of the gear cases, and they are operated synchronously with the clutches by the relay control switches.

Referring now to the accompanying drawings:—

Figure 1 is a view in front elevation of an electric lift machine illustrating an automatically operated and controlled car levelling apparatus according to the invention.

Figure 2 is a cross-sectional view on line 1—1 of Figure 1.

Figure 3 is a cross-sectional view of the auxiliary reduction and reverse gearing, showing the speed reduction gear case and the electro-magnetically controlled clutches.

Figure 4 is a wiring diagram showing the car switch, the cam switches in the lift well, the lift motor relays and the relay control switches for selectively controlling the electro-magnetically operated clutches and brakes of the auxiliary reduction and reversing gearing.

Figure 5 is a view in elevation illustrating a modification wherein the auxiliary reduction and reverse gearing are housed in the winding drum of the lift machine.

Figure 6 is a view partly in section of the modification shown in Figure 5.

Referring to Figures 1 to 4 of the drawings, 2 is the electric motor or power unit of an electric lift machine and 3 indicates the winding mechanism which may be of the worm-reduction gear type commonly adopted in lift machines. Arranged between the motor 2 and the winding mechanism 3 is auxiliary reduction and reverse gearing 4 comprising two gear cases 5 and 6 which are rotatably supported by standards 7 rigidly secured to a case 8 of substantial construction that also supports the said winding mechanism and the lift motor. The gear case 5 is constructed in two sections 5^a and 5^b which are rigidly secured together. Revolvably mounted in section 5^b of said gear case and extending outwardly therefrom is a shaft 9 which is coupled at its outer end to the spindle 10 of the lift motor 2—see Figure 1.

A double helical pinion 11 is carried by the inner end of the shaft 9 and it meshes with two epicyclic gear wheels 12 oppositely arranged within the gear case section 5^a. These gear wheels are keyed upon short spindles 13 journaled at their opposite ends in ball bearings 14 and 15 that are fitted in the cheeks of the gear case sections 5^a and 5^b respectively.

Fitted at the ends of the short spindles 13 and accommodated within the gear case sections 5^b are pinions 16 in mesh with a gear wheel 17 that is formed on, or is secured to, the end of a tubular shaft 18. This tubular shaft is revolvably accommodated within a sleeve 19 mounted upon the standards 7 and it provides a support for an enlarged boss 20, formed centrally upon the cheek of the gear case section 5^b.

The outer end of said tubular shaft 18 is tapered at 21, and rigidly fitted thereon is a cast metal clutch wheel 22 which has clutch plates 23 on the interior surface of its flange. This clutch wheel is maintained rigidly upon the tubular shaft 18 by a nut 24 on the said tapered end 21.

Revolvably supported within the said tubular shaft is an extension spindle 25, which is constructed having a flange 26 formed on its inner end for rigid affixture in approved manner to the web portion 27 of the gear case section 5^a. A ball bearing 28 is fitted in the flanged end 26 of said spindle 25 and revolvably supports the inner end of the shaft 9, which is coupled to the spindle 10 of the electric motor 2. Said extension spindle 25 is constructed having a tapered outer end 29, whereon is fitted a second cast metal clutch wheel 30, having clutch plates 31 fitted to the interior surface of

its flange. This clutch wheel 30 is retained rigidly upon the tapered end of said extension spindle 25 by a nut 32.

Arranged in longitudinal alignment with the extension spindle 25 is a third shaft 33, which is coupled at its outer end to the spindle 34 of the lift winding mechanism 3—see Figure 1. The inner end of said shaft 33 is also tapered as at 35 and keyed upon said tapered end is an annular shaped electro-magnet 36 having an armature 37 of disc shape, that is connected by rods 38 to a clutch disc 39 furnished with clutch plates 40. These last-mentioned clutch plates are normally maintained in driving engagement with the clutch plates 31 on the clutch wheel 30 by the tension of coiled springs 41 embracing the rods 38 and bearing against the electro-magnet 36 and the said armature.

Secured to the electro-magnet 36 is a sleeve 42, which passes around the clutch wheel 30 and is secured to a second electro-magnet 43 disposed adjacent to the clutch wheel 22. This electro-magnet 43 has its armature 44 connected by rods 45 to a clutch disc 46 having clutch plates 47 that are normally maintained in driving engagement with the clutch plates 23 on the clutch wheel 22 by the tension of coiled springs 48 embracing said rods 45.

The windings of the electro-magnets 36 and 43 are each separately connected to slip rings 49, to which current is supplied by contact brushes (not shown) that are connected to the selective control system hereinafter described. These slip rings 49 are fitted upon a panel 50 of insulating material, which is supported from the electro-magnet 36 by means of a ring 51.

Surrounding the section 5* of the gear case and also encircling the clutch wheel 22 are electro-magnetically operated brakes 52 and 53 each having brake shoes 54 that are pivoted at 55 to the standards 7. The shoes 54 of said brakes are normally maintained in engagement with the exterior surfaces of the gear case section 5*, and the clutch wheel 22 by means of coiled springs 56 which are attached to eye bolts 57 fitted in lugs 58 carried by said brake shoes.

The brakes 52 and 53 are operated by solenoids 59 and 60, which are attached to the brake shoes above the coiled springs 56 and each independently connected to the selective control system as hereinafter described.

Figure 4 illustrates the selective control system included in the invention, and in this view 61 indicates the lift car and 62 the car switch. The "down" contact 63 of said car switch is connected in usual manner by a cable 64 to the electro-magnet 65 of the "down" lift motor relay 66, while the "up" contact 67 of said car switch is connected by the cable 68 to the electro-magnet 69 of the "up" lift motor relay 70.

Each of the lift motor relays 66 and 70 is connected in the usual manner by cables (not shown) to the electric lift motor 2, and also by wires 71 to the power lead designated by 72.

The lift motor relays 66 and 70 are also electrically connected by wires 73 and 74, respectively, to relay control switches 75 and 76. The contacts 77, 78, 79 and 80 of said relay switches are independently connected by wires 81, 82, 83 and 84, respectively, to the clutch electro-magnets 36 and 43 and to the solenoids 59 and 60 of the electro-magnetically operated brakes 52 and 53.

Provided on the car switch 62 are contacts 85 connected to the power lead 86 and there are also contacts 87 and 88 connected by wires 89 and 90, respectively, to contacts 91 and 92 of a selector switch 93 that is mechanically operated by the action of the lift motor relays 66 and 70.

The contact 91 of said selector switch is connected by a wire 94 to the electro-magnet 95 of a relay 96, while the contact 92 of said selector switch is connected by a wire 97 to the electro-magnet 98 of a relay 99.

The relays 96 and 99 each have three switch arms 100, 101, 102, 103, 104 and 105 respectively, having contacts 106, 107, 108, 109, 110 and 111. The contacts 106 and 111 of said relays are connected by a wire 112 to the cam switch circuit 113 having cam switches 114 arranged in the lift well, while the contacts 108 and 109 of said relays are connected by a wire 115 to a cam switch circuit 116 having cam switches 117, that are also arranged in the lift well.

The contact 107 of the relay 96 is connected by a wire 118 to the cable 68 that is wired to the "up" contact 67 of the car switch, while the contact 110 of the relay 99 is connected by a wire 119 to the cable 64 that is wired to the "down" contact 63 of the car switch.

The switch arms 100 and 103 of said relays 96 and 99 are connected by a wire 120 to the electro-magnet 121 of the relay control switch 75, while the switch arms 102 and 105 of said relays are connected by a wire 122 to the electro-magnet 123 of the relay control switch 76. Both of said electro-magnets 121 and 123 of the

relay control switches 75 and 76 are connected by a wire 124 to the neutral or middle wire 125 of a three wire distribution system.

The switch arms 101 and 104 of the relays 96 and 99 are respectively connected by wires 126 and 127 to the electro-magnets 95 and 98, and they are also both connected by a wire 128 to a common cam switch circuit 129.

The switch arms 100 and 105, and 102 and 103 have auxiliary contacts 130, 131, 132 and 133, respectively, which are connected by wires 134 and 135 to the neutral wire 125. These auxiliary contacts are arranged to automatically break circuit with the neutral wire 125, when either of the switch arms 100 or 105, and 102 and 103 is closed, thus providing electrical interlocking means, which will prevent both of said pairs of switch arms from operating at the same time.

In operation, when the lift car 61 is ascending, the car switch 62 will be moved to the right to make contact with the "up" contact 67. The current flowing through the cable 68 energizes the electro-magnet 69 of the "up" motor relay 70, and causes the lift motor 2 to be switched into use. The motor drives the shafts 9 and 10 and as both sets of clutch plates 23, 47 and 31, 40 are being maintained in driving engagement with each other by the coiled springs 48 and 41, the gear cases 5 and 6 are both rotated and the auxiliary reduction and reversing gearing is not in use, so that a direct and unreduced speed drive is transmitted by the shaft 34 to the winding mechanism 3 of the lift machine. Simultaneously, with the operation of the relay 70, the selector switch 93 is operated to cause contact to be made between the contacts 91.

Upon the lift car arriving near to the desired stopping point, the car switch 62 is moved to the "stop" position but before it breaks contact with the "up" contact 67, it engages the contacts 85 and thus enables current from the power lead 86 to flow through the wire 89 to the contacts 91 of the selector switch 93, and thence through wire 94 to the electro-magnet 95 of the relay 96. The energization of said electro-magnet causes the three switch arms 100, 101 and 102 of said relay 96 to be closed against the contacts 106, 107 and 108. The closing of the switch arm 107 allows current to then flow through the wire 118 to the electro-magnet 69 of the "up" motor 70, thus maintaining said relay closed. The lift motor 2 is thus not switched off and stopped by the car switch 62, but is maintained running in the same direction as originally by the current flowing through the switch arm 107 of the relay 96.

The closing of the switch arms 100 and 102 against the contacts 106 and 108 causes the cam switch circuits 113 and 116 to be closed, so that the operation of the lift machine is now controlled solely by the cam switches 114 and 117 in the lift well.

Should the lift car be at a level that is below the required stopping point when the car switch is moved to "stop" position, the car will operate the cam switch 117 to thus close the switch circuit 116. Current will then flow along the wire 115 and through the contact 108 and the switch arm 102 to the wire 122, and thence to the electro-magnet 123 of the relay control switch 76 and then through the wire 124 to the neutral wire 125. Said relay control switch 76 is thus operated to cause contact to be made with the contact 79. Current is thus caused to flow from the wire 72 through the motor relay 70 and thence by the wire 74 through the relay control switch 76 along the wire 83 to the clutch electro-magnet 36 of the reduction and reverse gearing 4.

The energization of the clutch electro-magnet 36 causes the armature 37 to be attracted against the action of the coiled springs 41 causing the clutch disc 39 to be moved inwardly and the clutch plates 40 on said disc to be disengaged from the clutch plates 31 on the clutch wheel 30.

During the energization of the clutch electro-magnet 36, current also flows from the wire 72 through wire 73 to the relay control switch 75 and through the contact 78 along the wire 82 to the brake solenoid 59, causing the brake 52 to be opened from the clutch wheel 22 against the action of the coiled springs 56. It will thus be observed that the clutch wheel 30 and the electro-magnet 36 are now disconnected and the brake 52 is released from the clutch wheel 22, while the electro-magnet 43 is still connected through the clutch plates 23 and 47 with the clutch wheel 22, and the brake 53 is still applied to the surface of the gear case section 5*.

The lift motor 2, now being maintained running in the same direction as originally by the switch arm 101 drives the shaft 9, which acting through the pinion 11, rotates the epicyclic gear wheels 12. Said gear wheels now drive the short spindles 13, which in turn rotate the tubular shaft 18, acting through the pinions 16 and the gear

wheel 17. By reason of the gear ratios of the said gear wheel 17 and the pinions 16, the tubular shaft 18 is driven at considerably lower speed than the shaft 9.

The tubular shaft 18 drives the clutch wheel 22, which acts through the clutch plates 23 and 47, and in turn rotates the electro-magnet 43. Said electro-magnet 43 then drives the electro-magnet 36 through the sleeve 42, causing the shaft 33 to be rotated and thus transmit motion to the winding mechanism 3 through the coupled shaft 34.

It will thus be seen that the motor 2 is connected through the auxiliary reduction gearing 4 to the winding mechanism 3, whereby the speed of the travelling lift car is very considerably reduced. The lift car thus moves upwardly under the reduced speed, until it has reached the correct stopping point, when the cam switch 117 is released to interrupt the switch circuit 116 and allow the electro-magnet 123 of the relay control switch 76 to be de-energized. The contact at 79 is thus broken, so that the clutch electro-magnet 36 is de-energized to allow the armature 37 to move outwardly under the influence of the coiled springs 41 and again bring the clutch plates 40 into engagement with the clutch plates 31 on the clutch wheel 30. Simultaneously with the de-energization of the clutch electro-magnet 36, the electro-magnet 69 of the motor relay 70 is also de-energized causing the motor 2 to be stopped and both of the brakes 52 and 53 to be applied.

Should the lift car have over-run the required stopping point, the cam switch 114 will be operated causing the cam switch circuit 113 to be closed to allow current to flow along the wire 112 through the contact 106 and the switch arm 100, and thence by the wire 120 to the electro-magnet 121 of the relay control switch 75. Said relay control switch 75 is thus operated to cause contact to be made with the contact 77, and allow current to flow through the wire 81 to the clutch electro-magnet 43. The energization of said clutch electro-magnet 43 causes the armature 44 to be attracted causing the clutch plates 47 on the clutch disc 46 to be moved out of engagement with the clutch plates 23 on the clutch wheel 22. During the energization of the electro-magnet 43, current also flows through the contact 80 of the relay control switch 76 and along the wire 84 to the solenoid 60 of the brake 53, causing said brake to be released from the gear case section 5*. It will thus be seen that the electro-magnet 43 has been energized to release the clutch wheel 22, and the electro-magnet 36 is de-energized, while the brake 53 is released from the gear case section 5*, and the brake 52 is applied to the clutch wheel 22.

The lift motor 2, being maintained running in the same direction as originally by means of the switch arm 101 as previously described, drives the shaft 9 causing the pinion 11 and the epicyclic gear wheel 12 to be rotated. The short spindles 13 are thus driven to cause the pinions 16 to rotate around the gear wheel 17 which is now maintained stationary by the action of the brake 32 on the clutch wheel 22. The gear case 5 is thereby driven causing rotation of the extension spindle 25, which in turn drives the clutch wheel 30. Said clutch wheel 30 acting through the clutch plates 31 and 40 now drives the electro-magnet 36 and causes the shaft 34 to be rotated. The lift motor, by being connected to the winding mechanism 3 in the manner described, causes said winding mechanism to be driven at reduced speed in reverse direction, whereby the lift car is returned to the correct stopping point without necessitating reversal of the motor. When the lift car reaches the required stopping level, the motor 2 is automatically stopped, the clutch electro-magnet 33 is de-energized and both the brakes 52 and 53 are automatically applied in the manner before described by the cam switch 114 in the lift well.

When the lift car is travelling down, the car switch 62 will be moved to the left to make contact with the "down" contact 63 and allow current to flow through the cable 64 to the electro-magnet 65 of the "down" or reverse motor relay 66 to cause the direction of the motor 2 to be reversed. Simultaneously with the operation of the motor relay 66, the selector switch 93 is operated to cause contact to be made between the contacts 92. On arrival near to the required stopping level, the car switch 62 is moved by the lift attendant to the stop position, as previously described, to allow current to flow through the wire 90 to the contacts 92 of the selector switch 93, and thence through the wire 97 to the electro-magnet 98 of the relay 99. The energization of said relay electro-magnet 98 causes the three switch arms 103, 104 and 105 to be closed against the contacts 109, 110 and 111. The closing of the switch arm 104 against the contact 110 allows current to flow through the wire 119 to the electro-magnet 65 of the "down" motor relay 66, thus maintaining said relay closed and keeping the lift motor rotating in reverse direction.

The closing of the said switch arms 103 and 105 against the contacts 109 and 111 causes the cam switch circuits 113 and 116 to be closed in readiness whereby the operation of the lift machine is now controlled solely by the cam switches 114 and 117 in the lift well. The lift car will now operate either the cam switch 114 or the cam switch 117, according to whether it is above or below the required stopping level, to cause the operation of the brakes and clutches as previously described.

Figures 5 and 6 illustrate a modification of the invention wherein the drum 136 of the winding mechanism is coupled directly to the motor 2, and the auxiliary reduction and reverse gearing and the electro-magnetically operated clutches are housed in said drum. In this form of apparatus, the shaft 9 has a reduced portion 137 upon which the pinion 11 is fitted, and said pinion meshes with the two epicyclic and oppositely arranged gear wheels 12 that are fitted on the short spindles 13 mounted in the ball-bearings 14 and 15 provided in the sides of the gear case 5. Fitted at the ends of the short spindles 13 are the pinions 16, which mesh with the gear wheel 17 formed on the tubular shaft 18. The winding drum 136 is loosely mounted upon a sleeve 138 arranged around the tubular spindle 18, and it has clutch plates 139 and 140 fitted on its interior surface. Rigidly fitted to the end of the tubular shaft 18 is a clutch electro-magnet 141 having its armature 142 mounted on rods 143 attached to said electro-magnet. Fitted upon said rods 143 adjacent to the armature 142 is a clutch disc 144, which has clutch plates 145 that are normally maintained in driving engagement with clutch plates 139 on the winding drum 136 by coiled springs 146 encircling said rods 143.

A second clutch electro-magnet 147 is rigidly secured to the gear case 5, and its armature 148 has rods 149 upon which is mounted a clutch disc 150 having clutch plates 151 that are normally maintained in engagement with the clutch plates 140 on the winding drum 136 by coiled springs 152 surrounding the said rods 149. Slip rings 153 and 154 fitted on insulating panels 155 and 156 are arranged on the end of the electro-magnet 141 and also on an extension 156 on the gear case 6 to enable current from the relay control switches 75 and 76 to be conveniently supplied to said electro-magnets 141 and 147. The brakes 52 and 53, although not shown in Figures 4 and 5, are arranged to act upon the exterior surfaces of the electro-magnet 141 and the gear case 5 and they are operated and controlled by the relay control switches 75 and 76 in the manner hereinbefore explained.

When the relay control switches 75 and 76 are operated in the manner described, the brake 53 will be applied and the brake 52 will be released, while the electro-magnet 147 will be energized, causing the clutch plates 151 to be disengaged from the clutch plates 140 on the winding drum 136. The lift motor 2 is maintained running by the relays 96 and 99 and now drives the pinion 11, which rotates the tubular spindle 18 acting through the gear wheels 12, the short spindles 13 and the gears 16 and 17. The said tubular spindle, in turn, drives the electro-magnet 141, which acting through the clutch plates 145 and 139, drives the winding drum 136 at considerably slower speed than the motor shaft 9. The lift car will thus be caused to travel at slow speed until it arrives at the required stopping level.

When the reduction gearing is reversed by the relay control switches 75 and 76, the brake 52 is applied to the electro-magnet 141 and the brake 53 is released, while the electro-magnet 141 will be energized to cause the clutch plates 145 on the clutch disc 144 to disengage from the clutch plates 139 on the winding drum 136. The lift motor then rotates the pinion 11, which in turn drives the spindles 13 and causes the casing 5 to rotate with the pinions 16 running around the now stationary wheel 17 on the said tubular shaft. The rotation of the casing 5 causes the attached electro-magnet 146 to be rotated, which, in turn, drives the winding drum 136 in reverse direction through the clutch plates 131 and 140, whereby the lift car travels at slow speed and in reverse direction to the required stopping level.

The improved lift car levelling apparatus has been found to be highly efficient in use, and as the actual stopping of the lift car takes place at low speed, the operation is exceedingly smooth and pleasant to the passengers. Moreover, the lift motor does not require to be reversed during a trip or to be stopped unnecessarily with the result that the motor and lift machine are not subjected to any unnecessary wear, while a considerable saving of time and power is also effected.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In an electrically operated lift, the

combination with a lift car and lift machine of auxiliary reduction and reverse gearing interposed between the lift motor and the winding mechanism, relay control switches controlling said reduction and reverse gearing, relays connected to said relay control switches and automatically switched into and out of use by the car switch, and cam switches in the lift well for operating said relay control switches according to the position of the lift car relative to a required stopping level.

2. In an electrically operated lift, the combination according to Claim 1, wherein the auxiliary reduction and reverse gearing has electro-magnetically operated clutches and brakes connected to the relay control switches.

3. In an electrically operated lift, the combination according to Claim 1, wherein the auxiliary reduction and reverse gearing comprising epicyclic speed reduction gear, a direct drive clutch, a reverse drive clutch, electro-magnets for controlling said clutches, and connections between said electro-magnets and the relay control switches.

4. In an electrically operated lift, the combination according to Claim 1, wherein the auxiliary reduction and reverse gearing comprises epicyclic speed reduction gear, a direct drive clutch wheel, a reverse drive clutch wheel, clutch plates on each of said clutch wheels, an electro-magnet for each of said clutch wheels, armatures on said electro-magnets, clutch discs connected to said armatures, clutch plates on said clutch discs engaging the clutch plates on the clutch wheel, and electrical connections between said electro-magnets and the relay control switches.

5. In an electrically operated lift, the combination according to Claims 1 and 4 wherein the clutch discs are connected to the armatures of the electro-magnets by rods having coiled springs for maintaining the clutch plates on said clutch discs in driving engagement with the clutch plates on the clutch wheels.

6. In an electrically operated lift, the combination according to Claim 4 wherein the electro-magnets are of annular shape and are connected together by a sleeve.

7. In an electrically operated lift, the combination according to Claim 1, wherein the auxiliary reduction and reverse gearing comprises two gear cases, epicyclic speed reduction gearing housed in one of said gear cases, a tubular spindle connected to said epicyclic speed reduction gearing, a central spindle connected to the gear case, a direct drive clutch wheel mounted on said tubular spindle, a reverse drive clutch mounted on said central spindle, clutch plates on both of said clutch wheels, an electro-magnet for each of said clutch wheels, a sleeve connecting each of said electro-magnets, armatures on said electro-magnets, clutch discs connected to said armatures, clutch plates on said clutch discs engaging the clutch plates on the clutch wheels, and electrical control connections between said electro-magnets and the relay control switches.

8. In an electrically operated lift, the combination with a lift car and lift machine of auxiliary reduction and reverse gearing interposed between the lift motor and the winding mechanism, relay control switches selectively controlling said gearing, relays connected to said relay control switches, and automatically switched into and out of use by the car switch, motor relays connected to said car switch and to said relays, a selector switch operated by said motor relays, and cam switches in the lift well for operating said relay control switches according to the position of the lift car relative to a required stopping level.

9. In an electrically operated lift, the combination with a lift car and lift machine of auxiliary reduction and reverse gearing interposed between the lift motor and the winding mechanism, relay control switches for selectively controlling said gearing, relays connected to said relay control switches, lift motor relays, connections between said relays and said motor relays for maintaining the lift motor running when the car switch is switched off, a selector switch operated by said motor relays, connections between said selector switch and the car switch, connections between said selector switch and said relays, cam switch circuits connected to said relays, and cam switches in said circuits arranged in the lift well for operating said relay control switches according to the position of the lift car relative to the required stopping level.

10. In an electrically operated lift, the combination with a lift car and lift machine of auxiliary reduction and reverse gearing interposed between the lift motor and the winding mechanism, relay control switches for selectively controlling said gearing, relays connected to said relay control switches, three switch arms on said relays, lift motor relays, connections between motor relays and one of said switch arms, a selector switch operated by said motor relays, counections between said selector switch,

and said relays, cam switch circuits connected to two of said switch arms, and cam switches in said circuits arranged in the lift well for operating said relay control switches according to the position of the lift car.

11. In an electrically operated lift car levelling apparatus substantially as herein described and illustrated in the accompanying drawings.

Dated this 15th day of December, 1924.

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Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1925

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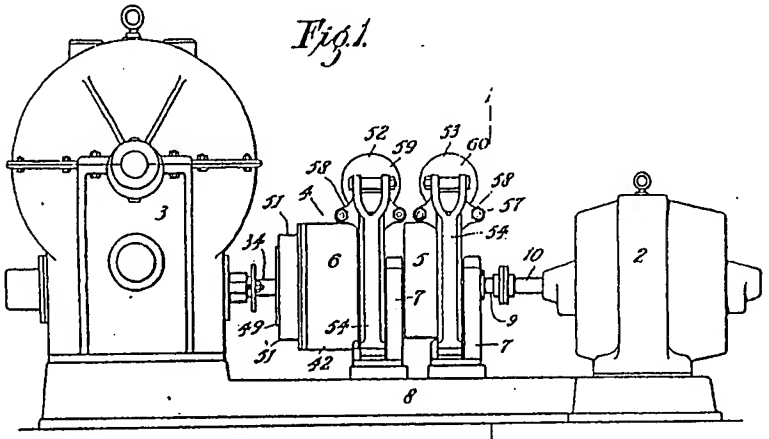
Fig. 1.



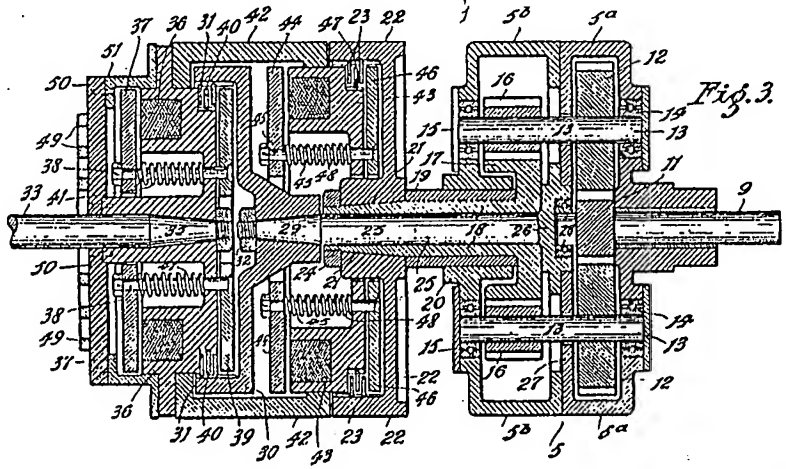


Fig. 3.

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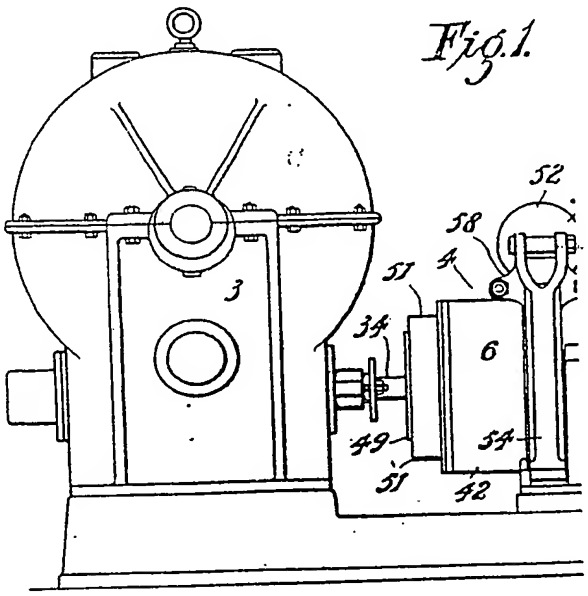
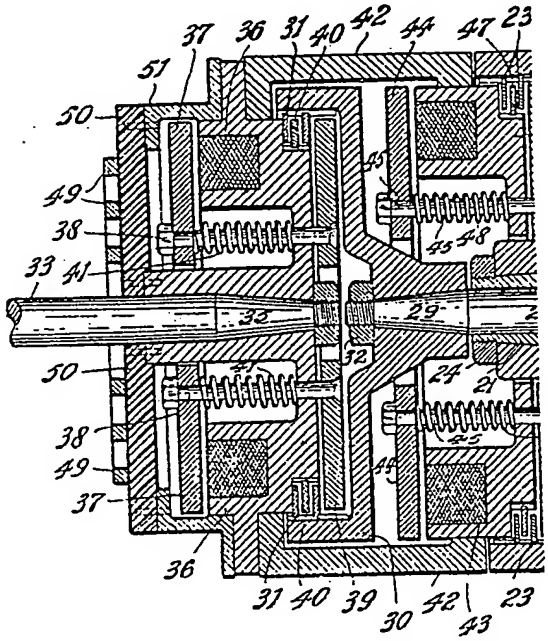
Fig. 1.





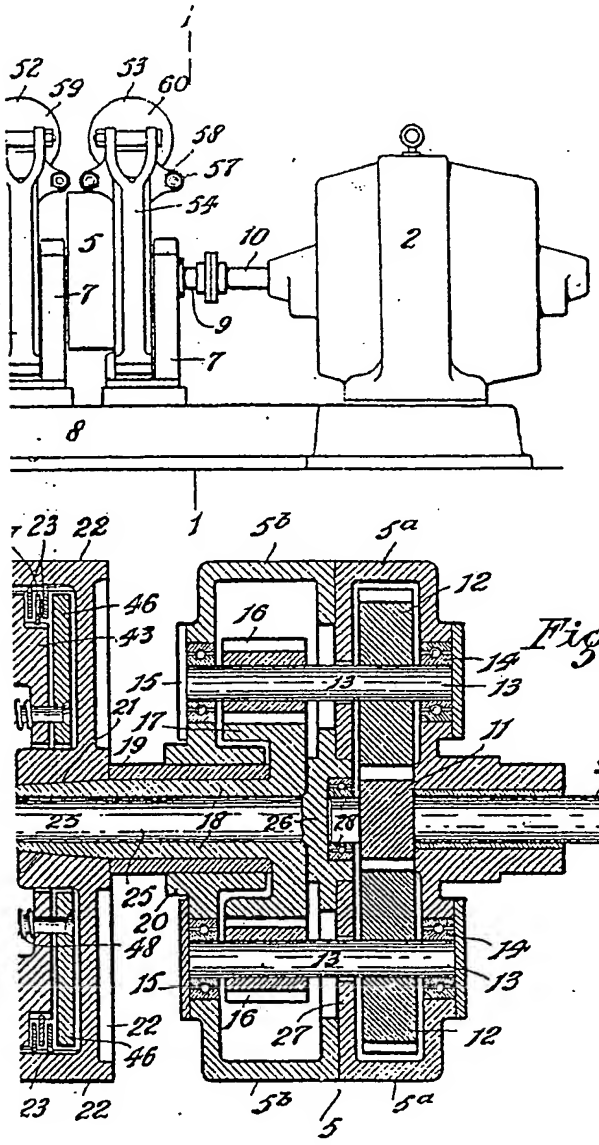

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Fig. 3.

Fig. 2.

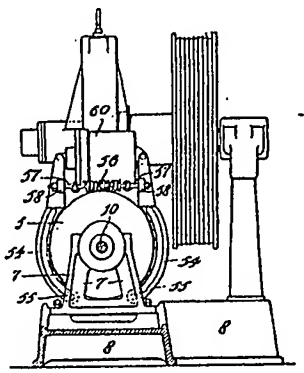
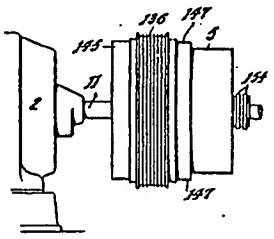


Fig. 5.



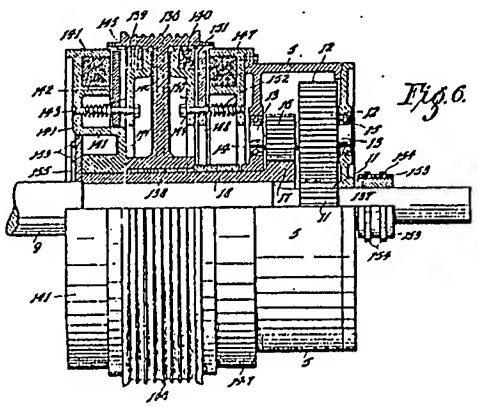
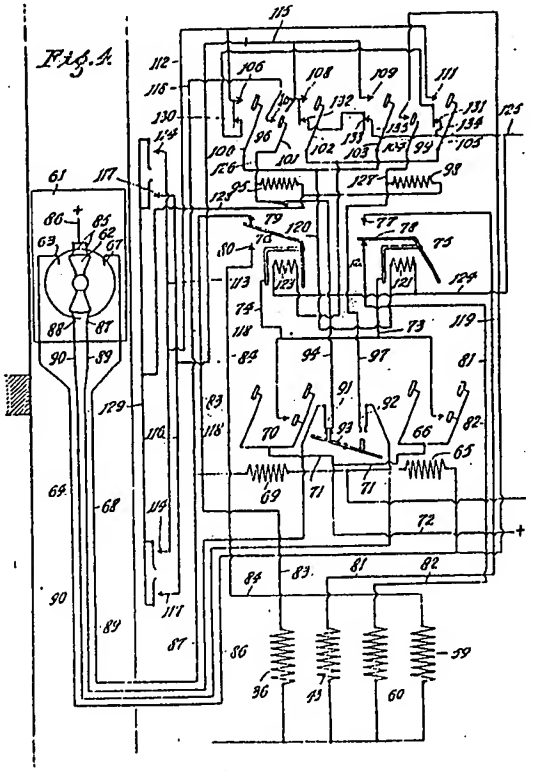


Fig. 6.

Fig. 4.



[This Drawing is a reproduction of the Original on a reduced scale]

Fig. 2.

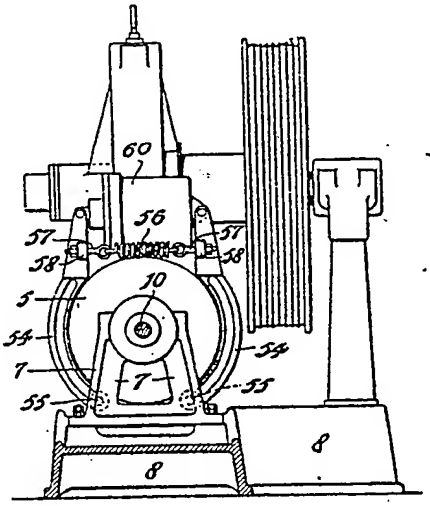


Fig. 5.

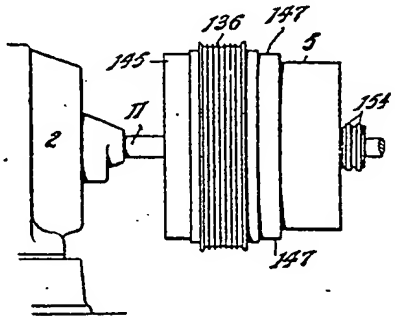


Fig. 6.

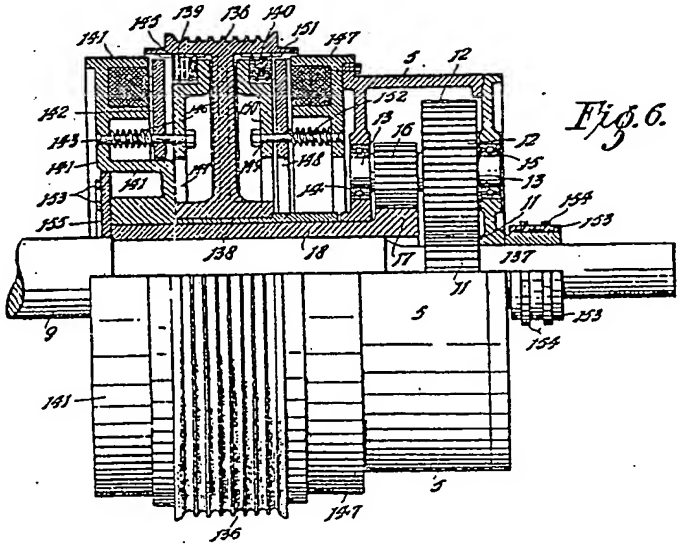
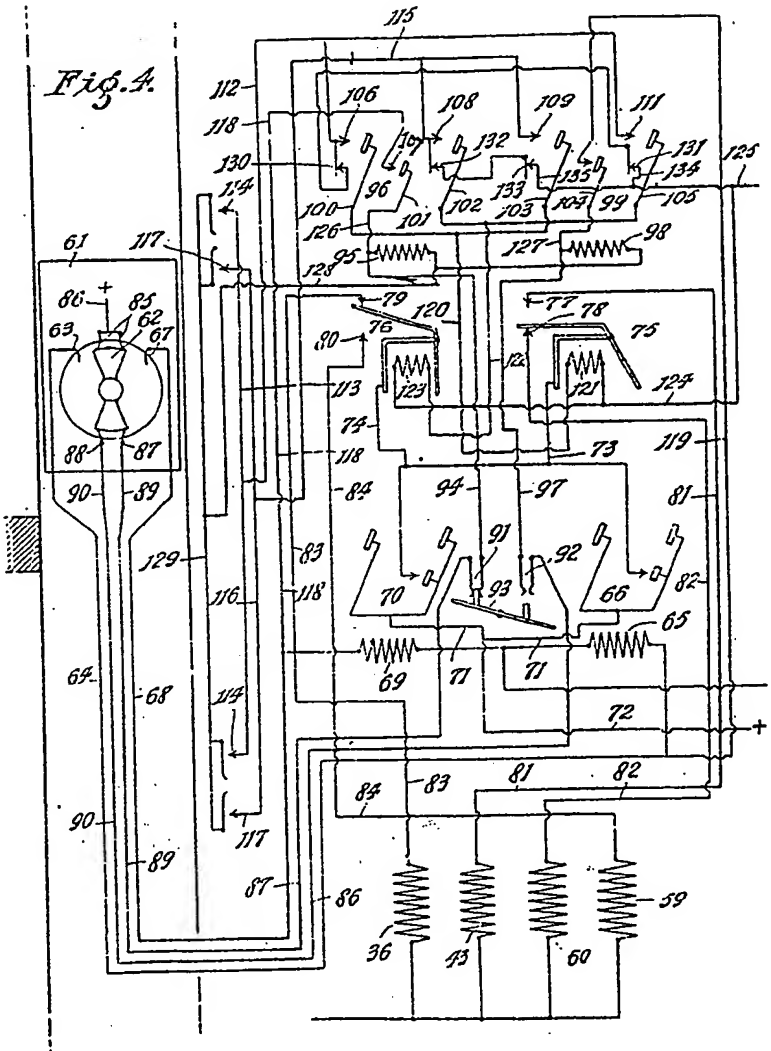


Fig. 4.



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